HOW SHALL A YOUTH BE TRAINED FOR THE OCCUPATION OF AN ENGINEER?

INDIANAPOLIS, Nov. 2, 1882.

TO THE EDITOR OF THE RAILROAD GAZETTE:

My advice having been asked in a matter upon which I cannot speak confidently, I have stated my position and promised to seek your assistance, expressing at the same time the confidence I feel in your judgment in such matters.

The case is this: A young man (Canadian) of 19, to be graduated in July at the Military College, Kingston, Canada, intending to adopt the profession of civil engineer, and to "make a specialty of railway construction and management," is considering seriously how the next year may be employed to his best interest "in the long run." He has under consideration.

1. Going into the field "under the direction of an experienced engineer."

2. Spending a year "in the workshops in Canada, the United States or in Europe."

3. Entering a mechanical school in the United States, France or Belgium.

The immediate income to be derived from the first and possibly from the second is not wholly a matter of indifference to him, yet he can forego it for any great professional gain in any other course. He thinks the advantage of the scientific lectures in France and Germany and the opportunity to perfect himself in the languages of those countries should, perhaps, be considered in connection with the foreign workshop or mechanical school.

Your opinion on the subject will be appreciated as a particular favor. S.

Some comments on the subject of this letter, by the editor of the *Railroad Gazette*, will be found in the following article on

THE EDUCATION OF ENGINEERS.

The excuse for saying anything about this rather threadbare subject will be found in the letter of inquiry above, in which the writer asks for "assistance" to aid him in advising "a young man, intending to adopt the profession of civil engineer" concerning the completion of his education. As similar inquiries are frequently made, it has seemed proper to write what may perhaps answer the other similar questions, or interrogative thoughts, which are entertained by persons interested in the same subject.

It may perhaps clear away some ambiguity and enable the young man who is seeking an education, and those who are about to advise him concerning it, to get a clearer view of what ought to be aimed at if he and they will form a more definite idea of what his career and occupation is likely to be than is indicated by the term "civil engineer." The opinion has herotofore been expressed in these columns, that it would be a distinct advantage to "the arts of directing the great sources of power in nature for the use and convenience of man," and to those who are engaged in the practice of such arts, if the word "engineer" and its derivatives could be entirely eliminated from our language, or their use be abolished. The term "civil engineer" has about it what Edward Everett would have called a "sonorous amplitude" of sound and meaning. It seems to mean more than it does, and experience soon teaches that the occupations it includes, instead of having about them a sort of super-exalted character, are usually very common-place indeed. It sounds well for a young man to say that he intends to be a "civil engineer." Fond mothers like to tell their intimate friends that Edmund intends to adopt that "profession." There is a rhythm about the name of it that makes it agreeable to tell to Angeline in soft and confidential tones, and she is apt to think that it produces a good impression to speak of the favored one as a "civil engineer," when the diamond or plain gold ring first makes its appearance in public. The word engineer carries with it many illusions, which, under such circumstances, it is rather pleasant to entertain, but which, if dispelled, would make the occupation much less attractive than it now is to many young men. In fact, it is only necessary to specify what the work of any engineer really is, and the illusions begin to fade away at once. Thus, accompanying the letter of inquiry was the card of the writer, whose firm is engaged in practical engineering work. On this card it is announced that they do railroad and other grading, difficult foundations, heavy masonry and steam pile-driving. Now assuming that the term "civil engineer" is banished from the language, and that our aspirant is aiming to qualify himself for doing the kind of work that this firm is engaged in, and that his aim is to get such an education as will best qualify him to become a railroad grader, to build foundations, to become a stone mason or a pile-driver, would not the question of the kind of education he ought to seek assume a very different aspect from what it does when he is aiming to become a "civil engineer?" Nevertheless, grading, building foundations, heavy masonry and pile-driving are branches of civil engineering.

But it may be said, that while this is true, the kinds of work named are only some of the branches of civil engineering; that they are not the only work of the "profession," that there is other work in which a thorough knowledge of mathematics and other science is required, and for which a person cannot be qualified who has not had a very complete theoretical training. Unfortunately for some of the theories regarding technical education, this statement is not true. There is not a branch of civil or mechanical engineering now practiced in this country in which the men who have achieved either the greatest distinction or pecuniary success have had a liberal education either classical or technical. If we turn to the special branch to which our young aspirant is looking, that of railroad construction and management, probably not one-fiftieth of those who now occupy prominent positions of that kind in this country have had anything approaching to what we call a liberal education. This shows in an indubitable way that such training is not *essential* to the success or to the attainment of distinction in these occupations. As a matter of fact, what can be learned in a common school is sufficient to enable a man to become eminent or successful in any branch of engineering. It is not said that a greater degree of knowledge of science or of literature, more skill in the use of language, or more education generally, may not be an additional help to an engineering aspirant.

The truth is, though, that in comparison with other qualifications, the value of any high degree of mathematical or scientific training is very slight. If the relative usefulness of different amounts of education were laid out graphically, so that its value would be represented by the height of vertical ordinates, a curve drawn through the different points laid down would probably assume the form of a semi-ellipse, with the conjugate axis for a base. The beginning of education would be seen to be of prime importance, and the curve would ascend almost vertically. When the elements are mastered, the curve would begin to incline from a perpendicular, and as the common school period is passed the inclination would probably be about 45°, and with the beginning of the course in a technical school the curve would approximate more and more towards a horizontal line and the rate of vertical increase would be less and less until it would begin to descend, slowly at first, but after a certain amount of scholastic training has been attained the rate of descent would be certain and after a while rapid. In other words, there is a degree of book learning which is an actual detriment to any one who engages in the occupation usually included under the general head of engineering. But when this period is reached our elliptical curve approximates so closely to a horizontal line for such a long distance and then ascends and descends so little above its base that it is not worth while to attempt to fix exactly the point at which it would intersect the transverse axis even if it were possible to do so. What we want to make clear here is, that so far as an aid to success is concerned it is the beginning of education that is the most important. After that additional attainments are a help, but their value soon begins to diminish and, after a certain point is reached, more study hinders and does not help to advancement. Those inclined to demur to this statement should, however, not infer more than is expressed. All that is asserted is, that so far as the achievement of success—that is, making money by honorable means—is concerned, the higher technical education is of little or no help. But there is something else in life worth having besides money and the power which it gives. To any one with a liking for what are called engineering occupations the pleasure to be derived from a thorough scientific and technical education would, to many people, outweigh all the pecuniary sacrifice which it would be necessary to make in getting it, and in the subsequent loss for having neglected other and more effective means of achieving what is ordinarily called success.

It will be well, though, if our young friend should at the outset make a distinction, and determine exactly what he wants most to get. The question might be stated somewhat in this way: the more knowledge he acquires beyond a certain point, the less money will he be able to make. Now it will depend altogether upon his tastes and circumstances as to what course it would be best for him to follow. If he has such a love for science and of knowledge as would make the possession of it a source of great pleasure to him during his whole after life, then we would by all means advise him in selecting the three alternatives named to select the last and take as thorough a course in one of the schools as he can afford time and money for. If, on the other hand, it is important or desirable for him to earn the most money in the least time, and if he has a fair elementary education, can use his own language with reasonable correctness, knows algebra, geometry and trigonometry, with more or less natural philosophy, or "physics," as it is now the fashion to call it, and some knowledge of mechanical drawing, our advice would be to plunge into practice at once.

There is some reason for suspecting, though, that he entertains some of the illusions which were referred to in the beginning of this article. Therefore we advise him never to say or think of becoming an "engineer." We have heretofore quoted the saying of Herbert Spencer, that "Science may be described as definite knowledge, in contradistinction to that indefinite knowledge possessed by the uncultured." In taking the last census in Great Britain those in charge of the work would not accept, as an answer to the question of what a man's occupation was, that he was an "engineer." They decided that the term does not indicate what a person's occupation is with the degree of definiteness demanded by the census. It might be well, then, if our inquring friend were to shape his aims and intentions into a form so definite that the British census-takers would accept it as an answer, if they asked him what his occupation is or will be. Our correspondent speaks of his "making a specialty of railway construction and management." It is to be feared that the British census-taker would not regard that as sufficiently definite. In fact it looks a little as though our young friend was a little vague in his ideas of exactly what he proposes to do. "Railway construction" involves a number of distinct occupations. Does he intend to locate lines where none are built? If so, he better attach himself to some party or "corps"—as they love to call themselves—of men in the field who are doing that kind of work. If he wants to learn about the grading of a line and doing the masonry work for its bridges, tunnels, etc., then he had better join a contractor and study the geometry of earthwork and the characteristics of the mule, gunpowder, nitro-glycerine and Hibernian, Italian and African laborers, with more or less of the literature of strikes. For either of these occupations the amount of theoretical education which has been specified would be sufficient for a fair start. If he aims at a knowledge of bridge-building, then he must keep in mind that, expressed after the manner of a boy's composition, there are different kinds of bridges, those made of wood, those made of stone and those made of iron. Each is a specialty of itself. With geometry, trigonometry and algebra, he can learn how to design and build bridges very much better if he enters the employ of some firm in that line of business, than he can in a technical school. If he means to turn his attention to rail manufacturing, then chemistry would help him, but he could pick up more knowledge which would be useful in a good rail mill than he could in all the laboratories in the world. Besides the mill has the advantage that the young railmaker can in odd hours learn as much chemistry as he will need, whereas the laboratory has the disadvantage that it is impossible, in it, to get the knowledge which the mill alone can teach.

If he means to learn how to take care of a railroad track, let him join himself to a section foreman—if he has the physical strength for it—as a truck laborer for a time; it will develop his muscles and he will learn how much work a man ought to do in a day, and he will get a glimpse of life from a day laborers' point of view, and thus be able to deal more justly with that class thereafter than he could without such experience. The ethics of doing this is not, we regret to say, usually taught in technical schools.

There is another branch of railroad construction, closely allied to rails, which is yearly growing in importance and in complication. That is the construction of frogs, switches, signals, etc. The business of manufacturing these appliances is carried on in special establishments devoted to this kind of work. There is almost no literature on the subject, and what could be learned about it in schools would be worth comparatively little to know. The best place to learn how to make frogs and switches is in a frog and switch shop. It is difficult to learn anything about signals any where, excepting in some of the large establishments devoted to that business in England or in one or two shops of that kind here. If this is impracticable, then the would-be learner must imitate the example of a hungry dog and pick up a morsel of information wherever he can find it, as the dog does his food. It will not do either for the learner in such a case to be too fastidious about the way in which such intellectual food is prepared, any more than the dog is about what he eats. The canine's example must also be followed by cultivating an instinct to discern information as the dog scents his food.

When it comes to the telegraph then looms up the illimitable field of electricity. The science of it which will be most useful to a future railroad constructor or manager could be learned in a few weeks or months in any telegraph office, and the leisure there afforded would give ample time to study up as much of the theory of electricity as will be required in ordinary practice.

Before leaving the permanent structures of railroads, something ought to be said of the stations, shops, water supply, etc. There is no way of getting information about the arragement of these excepting that which is analogous to the one our hungry dog employs in getting his food. There

are no schools, no books, no papers and no persons who seem to have any complete understanding of these subjects. The knowledge of building which an architect ought to have is not referred to. The place to learn that is in the employ of some competent person engaged in doing that kind of work.

If our young student means to turn his attention to the rolling stock of railroads, then the best place to learn how to make locomotives is in a shop where they build them. To learn how to manage them he ought to gain some experience in firing and running on the road, and then study the subject by working steadily at their repair in some railroad shop.

The same thing may be said of cars.

If he means to turn his attention to the traffic, or to the financial management of railroads, the office of a traffic manager or the chief executive office of a railroad would be an infinitely better place to learn what could be turned to account than any school could possibly be.

Many very intelligent persons have been advocates of workshop practice in schools. There are two things which it seems in the very nature of things must always make that kind of training very ineffective. First, there is the absence of the rigid discipline and accountability which exists in a well managed machine shop; and, second, the object for which every shop engaged in business exists is absent in the school. That object is the making of money and the production of machinery at the lowest cost and the best quality. In a real shop the learner must come early and work regular hours. He must do a fair day's work, and carelessness is not tolerated. He must in a measure compete with his fellow workmen under a rigid supervision. That kind of training alone is of great value to a young man, and that he does not get while playing at workshop for a few hours a day in a school.

But it may be said that the young inquirer does not want to be a railroad locater, a railroad grader and builder, a bridge-builder, a rail manufacturer, a track master, a switch or signal maker, a telegraph operator or superintendent, a locomotive superintendent, master car-builder or traffic manager. It may be that he wants to get a general knowledge of railroad construction and operation and educate himself for a general manager or a president. Now, if this is the case, there are some rather awkward questions which ought to be considered. Supposing that after he has completed such an education no one should happen to want him for a general manager or general superintendent, what would he do? It is true that competent men are always wanted for such positions, but those whose services are sought are men who have shown by what they have done that they are competent and have the ability to manage affairs. Our student would have no such reputation after he had laid up a stock of "general information," and he might find himself unable to get employment on the top shelf. Now general information would not help him to get employment lower down. What is wanted there is special knowledge. If he wants to be employed to locate a railroad or design a locomotive, he must be able to show that he knows how to do those things as well as or better than other people. In other words, to get employment he must know how to do some one or more things in the best way.

The writer remembers soon after emerging from the chrysalis state of his apprenticeship seeking the help of the man who before that occupied the relation of master to him, in getting employment, and he (the writer) gravely asked his former employer what position the latter would advise the emancipated apprentice to *take*. The old man hesitated a moment, and then with an expression on his face like that which General Butler probably assumed on hearing the news of the late election in Massachusetts, advised the writer "to take whatever position he could get."

During the same apprenticeship there was a philosopher workman who "run" a drill-press next to the writer of this too long article. He was given to saying that "in order to get on in the world a man must conceive himself to be a wedge, and when he sees an opportunity he must insert himself." We will finish this article by advising our friend in search of an education, first to abandon the use of the term civil engineer; it will clear away some things that are foggy now; next: to learn to do some one thing, like locating railroads, building bridges, or making signals, or repairing cars as well as or better than any one else; then take "whatever position you can get," and after that conceive yourself "a wedge," and look out for opportunities.

Of course if a young man has wealth and influence and is independent of his own achievements, then the case might be different, and merely for the pleasure it would give a thorough classical or technical education might be advisable. The present or late president of the British Institute of Mechanical Engineers, who is a partner of Sir William Armstrong, determined a year ago in educating his son to succeed him, first to put him in the shop and then give him a classical course at Oxford.

The great practical advantage of an education in "railway construction" is the discipline it gives to the mind, so that the person has the free use of his intellectual faculties, as a gymnast has of his muscles.

Much less training than that of a full course in a technical school or college gives this to a sufficient degree for all the practical purposes of success in what ought *not* to be called the engineering occupations.

To the Editor of the Railroad Gazette:

Your valuable paper has an editorial article, "The Education of Engineers," in the issue of Nov. 10, 1882, some parts of which the writer, as a civil engineer with over thirty years' experience, cannot read without an earnest protest.

I have enjoyed your paper for years. Why? Because it treats of many of the various topics which interest the civil engineer who "makes a specialty of railway construction and management."

Is it not as competent for a civil engineer to know personally and practically of these subjects, as for a *Railroad Gazette* to collate and print concerning them?

Your editorial *asks* too narrow a view. Civil engineers of the past twenty years have had good knowledge of all the various points it touches upon, and many more besides, and the best of them did not get their reputation by following any *one* of the footsteps you mention.

My answer to the young man who "intends to adopt the profession of *civil engineer*, and to make a specialty of railway construction and management," who has graduated at the Military College, Kingston, Canada, and is seriously considering how the next year may be employed to his best interest in the long run, is his *first* alternative, premising that he has profited by his opportunities, is a good mathematician and draughtsman.

"Going into the field under the direction of an experienced engineer."

Why? He does not ask to become a mechanical engineer. If that were his desire, then take his second alternative, and after two or three years of work he will know what he wants from his third alternative.

Education and practice combined, experience is what he requires, in the line of his query and upon his premises.

By obtaining an inferior position in a field party of engineers, he begins at the beginning of railway construction, soon learns how to obtain data for his own mathematical determinations; as the pleasure of solving peculiar problems not found in books, as well as applying those printed, overbalances the toil and privation of his field work, he acquires the habit of noticing the peculiar features of the country; this increases until after years (not one or two) of practice he imperceptibly acquires a "knack" at combining them which will give his judgment weight with the parties who are investing money, even before he is instructed with the surveys and arrangement of the various and apparently conflicting items which weigh in the balancing of comparative advantages.

Naturally following the surveys, often intermixed with them, and thus, while a young man, he comes upon railway designs and construction. Here he practically sees not only the work of one engineering firm or contractor upon grading, foundations, masonry, bridging, etc., but becomes conversant with the modes of many, and observes which answers best for various localities and different circumstances, and why some contractors lose money in positions similar to these of others who make money; but more than these. Which modes do the work in the *best* manner as well as the ones which are the cheapest, for the cheapest is not always the best. Thence to tracklaying, station building, water supply, terminal facilities, and incidentally rolling stock. All of these he can learn, and *will* learn, if intending to become a civil engineer for railway construction. You may inquire of most of our experienced civil engineers (railway), and they will give correct ideas in regard to any of the items you mention, and their ideas will weigh *both* with investors and contractors.

They *must* know these matters experimentally in order to *fill* their positions.

By all means obtain all the theoretical basis possible, then strive for a varied experience.

An *engineer's* success is *not* "making money by honorable means;" it is the reputation of readily and skillfully adapting the resources of the country to their highest development in the work at hand. A civil engineer may as well at once give up the idea of "making money" strictly in his legitimate profession, but he might, and does, make a fair living, a respected position in the world; *he lives an useful and honorable life.*

It would seem that your writer has lived too long in New York, where (naturally as the financial center) to make money is the aim of the mass. There are other and better objects, objects that expand instead of diminishing the intellect, cultivate and enlarge the mind, enoble the spirit and the life.

Look at our good civil engineers of the past as well as of the present. Many have most worthily *filled* positions requiring intimate knowledge of all and many more than the branches you suggest, being entrusted without oversight, with the expenditure of immense sums of money, because they *knew* what they were about, were not brought up in any one school or corps, with any one contractor, mason, bridge-builder, trackman, manufacturing or engineering firm, but have culled the best from all.

The young man wishes to learn more than the engineering firm specifies that it does, although to do that well is a heavy business of itself.

He wants to include a knowledge of their business and this is why your correspondent of the engineer's firm writes to your paper.

There is a profession of civil engineers and it will be maintained so long as the material world progresses. There are and will be civil engineers for railway construction so long as railroads are designed or built.

Upon any regular meeting of the American Society of Civil Engineers, let a stranger visit their rooms and see the honest, earnest endeavor for the truth in all practical matters. He will see no show, but if he becomes acquainted with the members he will find a vast amount of solid facts and varied experience with the use of those facts.

"A rose by any other name would smell as sweet," but there is the rose, what better name can you suggest? No! the only modifications to the term of civil engineer are those now well understood, which shows the specialties, as railway, hydraulic, mining, bridge, sanitary, mechanical, gas, electric, etc., and a member of either should and does necessarily have a fair acquaintance with the learning and practice of the others.

The name civil engineer should have a sonorous amplitude, for thorough practice in the profession will give such corresponding breadth of vision that the true engineer will find there is always something to learn. All of the world's materials are his resources and all of nature's activities are his agents.

The editorial is generally too discouraging, too narrow for a young man. "There is always room at the top." In order to get *there* one must begin at the bottom of the ladder, and he will find it safer as well as easier to put in *every rung* as he ascends.

Full well I remember the reply to me, thirty years ago, of a civil engineer then eighty years old, when I was as anxious as this young man: "Are there any more railways to be built? Will the business last?" "Never you mind that problem; the older you grow the more you will see to be done, until, at my age, you will think the engineering world just begun."

The last part of your editorial is superior to the rest, but even there I would say for encouragement to the engineers, that, like the usual experience of earnest, active men in other pursuits, there will be times when he will be puzzled what position to *take*, as well as times when he will be glad for anything he can *get*.

As to railway *management*, if administrative or executive ability develops under the extremely favorable conditions of the life of a civil engineer, he will be sought for, wherever promptness, system, accuracy, tact, versatility, decision, broad views, are required. In proof of this, I see many among my engineering acquaintance who now worthily fill such positions, who preferred to deal with men and measures after successfully handling the resources of nature.

Judging from the tone of the article, it was not written by one in the active pursuit of the profession, consequently I intrude upon you from the stand-point of a civil engineer.

ROBERT L. HARRIS, C. E.,
No. 80 Columbia Heights, Brooklyn N. Y. Nov. 11, 1882.

BINGHAMTON, N. Y., Nov. 13, 1882.

To the Editor of the Railroad Gazette:

I have read your editorial on the "Education of Engineers," with much interest and some dissent.

Your remarks on the diffuseness of the term "Civil Engineers," are to the point, and are too true; but to sink the whole term would be only the change from the frying-pan to the fire. It seems to me that the proper cure is to suit the prefix to the occupation, and use such terms as "Construction Engineer," "Bridge Engineer," etc.

Your statement that there is no branch "of civil or mechanical engineering" in which the successful have had a "liberal education, either classical or technical," is largely disproved by the facts. The chief engineers of the first three railroad systems that occur to me are all men of such education. The largest of the three employs engineers of such education by preference.

Your idea that a man must be practically acquainted with the work he is to do before he can be successful in it is self-evident.

Where your advice to young men fails is that you would have them decide their course in life at an age when they are not fit to make the decision. This is, I submit, a fruitful cause of the many misdirected lives that we see. They choose too young. Right here the technical school steps in and fits the young man as the training, which you so aptly refer to, fits the athlete for his life work. The three or four years of severe mental labor mature his mind, quicken his ability to see his way through a difficulty, and perhaps, best of all, teach him where to look for any information he may require. He has stored away a vast index of knowledge. He is now a man ready to choose his special work. Does he intend to locate lines where none are built? He can run transit, level or rod; he can take notes on topography or map the line, not rapidly at first, but surely faster than if he had no such knowledge. If he wants to learn "grading and masonry," is he the worse off for knowing the laws that govern the stability of these materials? "If he aims at a knowledge of bridge-building," a knowledge of how to work strain-sheets and the strength of materials is not far amiss. And so on through your long list of the special branches of the "profession" there is not one in which his training will not be of use to him.

To repeat, there is about as much sense in a boy of eighteen or nineteen—except in rare cases—choosing his course in life as in the unwritten law of our kinsmen across the water that makes the eldest son the heir, the second a soldier and the third a clergyman; they differ but in degree of their unwisdom. A CIVIL ENGINEER.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 400.)

CCCCXII.—EASTON, PA.

Easton, Pa., in lat. 40° 42′ N., long. 75° 8′ W., on the Delaware River, is on hilly ground between the mouths of Bushkill Creek and the Lehigh River.

Settled in 1738, it was incorporated as a borough in 1789.

Water-works were built by a private company in 1820. No account of these works has been obtained. In 1854 the Lehigh Water Company, which now supplies the town, was organized, and built works after plans of John West, taking the supply from the Lehigh River, and pumping into reservoirs by a Cornish Bull engine, erected 1860. In 1882 new pumping works have been erected after plans of H. P. M. Birkinbire, C. E., taking their supply from the Delaware River, and pumping by a Corliss engine of 2,000,000 gallons daily capacity. The water is lifted 250 feet into two reservoirs, one 180 by 160 ft., the other 100 ft. square, at 100 ft. above the general level of the town.

Distribution is by 20 miles of cast-iron pipe of from 20 to 3 in. diameter, with 50 fire hydrants, 100 gates and 1,200 taps. There are 20 meters in use.

The town does not pay for fire hydrants. Service pipes are of wrought iron.

A portion of Phillipsburg, N. J., on the opposite side of the Delaware River, is also supplied by this company.

The population of Easton was 11,924 and of Phillipsburg 7,109 in 1880. The daily consumption in 1881 was 1,000,000 gallons.

The capital stock of the company is $200,000. The works have cost $300,000. The bonded debt is $40,000, at 6 per cent. interest. The expenses in 1881 were $10,000, and the receipts $23,500.

John Maxwell is president of the company.

CCCCXIII.—BOWLING GREEN.

Bowling Green, Kentucky, in lat. 37° N., long. 86° 25′ W., at the head of navigation at Barren River, is in a basin surrounded by hills at a distance of 5 to 8 miles. The surface rock is limestone, but the river rises in a sand-stone region and the water contains little lime. Much of the drainage of the valley flows off through caverns in the subsoil, which is a heavy, red clay.

Settled in 1787, it was incorporated as a town in 1797.

Water-works were built by the town in 1868, after plans of Charles H. Hermany, C. E. Taking the water from the river and lifting it 237 ft. by a steam pump with vertical cylinder of 9 in. bore and 30 in. stroke, into a reservoir of about 1,000,000 gallons capacity.

Distribution is by 6 miles of cast-iron pipe of from 8 to 2 in. diameter, with 100 fire hydrants and 500 taps. Lead and galvanized iron service-pipes are used.

The population in 1880 was 4,895 and the daily consumption 200,000 gallons.

The works have cost $100,000. The bonded debt is $85,000, at 6 per cent. interest.

The expenses in 1881 were $4,000, and the receipts $7,000.

The works are managed by a board of Commissioners. James Witherson is the Superintendent.

CCCCXIV.—SPRINGFIELD, ILL.

Springfield, Illinois, in lat. 39° 48′ N., long. 89° 33′ W., is on a prairie, 5 miles from the Sangamon River.

Settled in 1822, it was made the State capital in 1837, and incorporated as a city in 1840.

Water-works were built by the city in 1866, taking the supply from the Sangamon River. A conduit 80 ft. long conducts the water from the river to a pump well, whence it is pumped into a reservoir of 4,000,000 gallons capacity. There is also a stand pipe 3 ft. in diameter and 70 ft. high. There was at first an Earnshaw engine, which in 1876 was replaced by a Worthington duplex engine of 3,000,000 gallons daily capacity. In 1877 the reservoir was cleared out, and 1,300 cubic yards of sediment removed from its bottom.

Distribution is by 19¼ miles of cast-iron pipe of from 15 to 4 in. diameter, with 91 fire hydrants, 180 gates and 753 taps. There are 31 meters in use.

The population in 1880 was 19,746. The daily consumption and the average number of taps in use for five years has been as follows:

	Daily Cons gallons.	No. of taps.
1877	908,104	563
1878	930,000	583
1879	1,285,000	625
1880	1,511,513	682
1881	1,653,524	730

The works cost $450,000 which is the amount of the bonded debt at 8 per cent. interest.

The receipts in 1881 were $28,607.22, and the expenses of maintenance $17,136.07.

The works are managed by three commissioners. L. R. Brown is Secretary and Fred McCarthy superintendent.

(TO BE CONTINUED.)

ADDITIONS AND CORRECTIONS.—May 13, p. 155, *Boulder Col.* The ditch from creek to reservoir is 5 by 2 ft., and 4,500 ft. long with grade of 5.38 ft. per mile. A setting basin is made in it 6 ft. wide at bottom and 18 ft. at top and 6 ft. deep for 400 ft. The reservoir is 15 ft. deep and and holds 2,000,000 gallons. There are 6.9 miles of pipe. A good deal of water used for irrigation and gardens. The population in 1880 was 3,250 and is now 4,000. The works have cost $47,500. The bonded debt is $30,000 at 10 per cent. and $17,500 at 8 per cent. The expenses in 1881 were $1,125 and the receipts $4,750.

April 2, 1881. *Boston Map.*—The Superintendents of the several divisions are, Eastern, Ezekiel R. Jones; Western, Desmond Fitzgerald; Mystic, Hiram Cutts.

November 11, 1882, p. 388. In the corrections for Middleton, N. J., read Middleton, N. Y.

The receipt of statistics, as follows, is acknowledged with thanks: From John Maxwell, President, statistics and water rates of the water-works of Easton, Pa. From John S. Titcomb, Engineer of water-works, revised statistics and water rates of the water-works of Boulder, Col. From M. H. Crump, City Engineer, statistics of the water-works of Bowling Green, Ky. From Charles E. Goad, C. E.; list of places having water supply in British possessions in North America. From J. F. LeBaron, C. E., partial statistics of the water-works of Arlington, Mass. From A. F. Matlock, City Clerk, report for 1881 of the water-works of Steubenville, Ohio. From the City Clerk, 14th, 15th and 16th reports of the water-works of Springfield, Ill.

PRICES AND WAGES.

Colonel Wright, of the Mass. State Labor Bureau, says, in his last report, that the advance in the price of the following articles as contrasted with the price of the same articles in 1878 is as follows:

Groceries have advanced in price 9.1 per cent.
Provisions have advanced in price 20.1 per cent.
Fuel has advanced in price 30.1 per cent.
Dry goods have advanced in price 9 per cent.
Boots have fallen in price 1.6 per cent.
Rents have advanced 35.1 per cent.
Board has advanced 13.7 per cent.

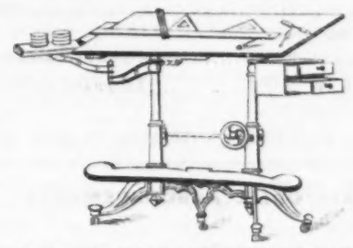
On all these items of expense entering into the cost of living, the average increase was 21.2 per cent.

Wages have not increased in the same ratio as the necessaries of life. In some trades there has been a falling off since 1878; in the boot and shoe trade Col. Wright says wages have decreased 4.4 per cent., in cabinet making the decrease has been 1.7 per cent., carpetings 7.9 per cent., carriage making 5.4 per cent., straw goods makers' work 2.7 per cent. less than they did in 1878. But on the whole there has been an increase averaging 6.9 per cent. That is, the cost of living is 21.2 per cent more than it was in 1878, while the advance in wages has only been 6.9 per cent.—*Worcester Times.*

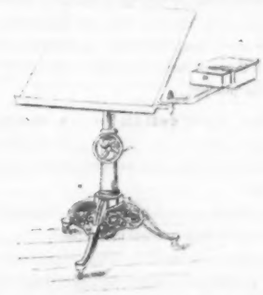
BIDS FOR WATER-WORKS REMAINING UNOPENED.—We have received the following note from Irvington, N. Y., in regard to the proposals for water-works which were recently received: "Owing to a notice of an intended proceeding at law to test the legality of the election on water-works by several taxpayers the bids have not been opened. They will not be until a decision is reached under the proceeding."

DRAWING TABLES.

Messrs. Keuffel & Esser, of 127 Fulton street, this city, have lately introduced a drawing table of new design, presenting many excellent characteristics. The table-top is raised or lowered to any convenient height, the mechanism for doing which consists of a rack and pinion movement. The top



may be adjusted to any desired angle by a slight shifting of a knob under the front of the top, and without the necessity of changing the position or interrupting the work. A bracket arm furnished with shelf and drawers may be moved to any position on either side. By a simple device a rack can be extended over the top and can be used to tem-



porarily increase the size of the table when using it as an easel, or for holding copies, etc.

The tables are built of the best materials, are simple in construction, and have strength and weight enough to make them firm and steady. Easels are made embodying the same principles of construction. From the accompanying engravings an idea may be obtained of the appearance and mechanism of two sizes, the larger being supported upon a double iron stand.

Particulars in regard to the "Favorite" drawing tables may be obtained from the manufacturers.

IRON MARKET.

[Carnegie Bros. & Co., Limited].
(*Net f. o. b. cars, Pittsburgh*).

	Cts.
Angle iron.	
Equal sided, ¾×¾ to 1×1 to 1¼× 1¼ in	3¼
" " 2×2 to 4×4	3¼
Unequal sided, 2×1⅝ to 4×6 in	3¼
Square-root angles, 1×1 to 6×6 in	3¼
Star iron, 1½×1¼ to 4×4	3¼
Sash iron, ¾×⅝×3-16	3¼
Various shapes	3¼ to 4
Tee iron.	
1 inch and upward	3¼
	Cents per lb.
Beams and Channels.	
Solid wrought-iron beams, 3 in. to 10½ in. by 30 ft.	4
12 in. by 30 ft	4
15 in. by 30 ft	4
Deck beams, 7 in. to 9 in. by 30 ft	4
Channel bars, 1 in. to 12 in. by 30 ft	4.2
" " 15 in. by 30 ft	4.2
Plate iron.	
Universal Mill Plates, plates not over 36 in. wide by ¾ in. thick and upward	3¼

STONE MARKET.

The present cargo rates for stone delivered at New York are as follows:

Amherst freestone, in rough, per cubic ft	$1.00
Berlin freestone, in rough	1.00
Berea " "	$0.85@ 0.90
Brown stone, Portland, Conn	1.50@ 2.00
" " Belleville, N. J	1.25@ 1.75
Granite, rough	0.75@ 1.00
Dorchester (N. B.) stone, rough, per ft	1.00
BLUE STONE.	
Rubbed hearth, 10 ft. or under	20c.
" " 20 " " "	30c.
" " 30 " " "	45c.
" " 40 " " "	55c.
" sills, imported	28c.
" " domestic	33c.
Sills and lintels	17c.
" " " fine quarry cut sills	35c.
Coping, 11 to 18 in. wide	18@30c.
" 20 to 28 " "	35@55c.
" 30 to 36 " "	60@75c.
Steps, 8 in	55c.
" 7 "	40c.
" 6 "	25c.
" door, per inch wide	02c.
Platforms, promiscuous, 4 in	33c.
SLATE.	
Purple roofing slate per square	$7.00@$8.00
Green slate	7.00@ 8.00
Red slate	15.00@ —
Black " Pennsylvania	4.75@ 5.25

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, NOVEMBER 25, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.25	1.50
Popular Science Monthly	4.25	5.00
St. Nicholas Magazine	2.55	3.00
Journal of the Franklin Institute	4.00	5.00
Van Nostrand's Magazine	4.00	5.00
North American Review	4.00	5 00
Sanitary Engineer	2.75	3.00
Railroad Gazette (new subs.)	3.50	4.20
" " (renewals)	3.90	4.20
American Architect	5.00	6.00
Scientific American	2.65	3.20

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do this we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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INTERESTED parties will please note the new advertisement published in this issue of the city of Nashville, Tenn., for proposals for pumping engines. In order to secure a larger representation of engine builders, the time for receiving proposals is extended to Dec. 11 ensuing, and additional engines are also called for. It is to be hoped that a very full and complete representation will be the result of the increase of time allowed.

ON THE EDUCATION OF ENGINEERS.

On another page will be found an article from the editorial columns of the *Railroad Gazette* concerning the education of civil engineers, which presents in a very clear and forcible manner the claims of practical training in actual business life as opposed to that acquired at technical schools. While entirely agreeing with our contemporary as to the value of the discipline of manual labor, the importance of actual practical experience, and the absolute necessity of working one's way up the ladder by beginning at the lowest steps, we yet feel that the main conclusion reached is not in all respects that which should govern a young man who is desirous of attaining success in some branch of civil engineering. This main conclusion concisely stated is about as follows: A young man who wishes to earn his livelihood in civil engineering, and ultimately gain a competence thereby, should not take a course of study in a technical institute or college, but should plunge into practice as soon as possible after having studied algebra, geometry, trigonometry, and acquired some knowledge of physics and mechanical drawing.

Now these branches of mathematics, together with the physics, are usually taught in most high schools and academies to pupils of sixteen or seventeen years, so a lad of that age, after spending a little time at drawing, would, under the plan proposed, enter at once upon the actual work of life as axeman or rodman on a surveying party, or as an apprentice in a locomotive shop. Here he is supposed, of course, to exert all his energies to learn thoroughly the work he is set to do, and to earn his promotion up the rounds of the ladder, never confining himself closely to his chosen specialty until he acquires reputation and distinction therein.

The lad who takes a course of technical study, likewise leaves the high school at the age of sixteen or seventeen, spends a year or two in preparation and enters upon that course at the age, say, of eighteen, and at the end of the four years of study graduates, aged twenty-two. Then he begins as rodman at the foot of the ladder and bends all his energies to work his way up. In practical experience and in ability to command wages he is five years behind the other lad. Now we claim that when these typical young men have attained the age of thirty, he who has taken the course of college training will not only have attained an equal degree of success with the other, but on the average will have far outstripped him in the race.

Our contemporary selects the ellipse as a curve whose ordinates and abscissas, measured from an origin at one end of the major axis, represent the relation between education and its relative usefulness in life. At first the curve rises perpendicularly, showing the beginnings of the education to be of great value, then its ordinates increase with less rapidity until the curve becomes horizontal and then begins to descend, showing that much education may diminish the chances of success. This happy illustration may indeed represent the facts if the word education be taken to mean book knowledge only, but such cannot be the case if it be taken in its true signification. To educate, says Webster, comes from *e*, out, and *ducere*, to lead, and signifies to bring up a child, to lead out and train the mental powers, to form the character, and to prepare and fit for business. Viewing education as a drawing out and training of the powers of the mind, we must regard the curve as ever ascending, not uniformly indeed, but perhaps after the manner of a parabola. And this view of the meaning of that word is, we think, the element that has given life to and won success for the new scientific methods of education and training. As a prominent educator once tersely expressed it, the aim of education is to teach a boy how to think.

When a lad of eighteen enters upon a course of study of four years in civil engineering, he has, or should have, the ability to use his own language with reasonable correctness, a fair knowledge of history of his own country, a good command of arithmetical processes, and an acquaintance with the elements of algebra and geometry. He ought to be in good health, have some degree of ingenuity, and be possessed with the determination to succeed in all his undertakings. Very desirable also is it that he should have had a practical acquaintance with some of the forces of nature which he aspires to control, such an acquaintance, for instance, as the carpenter's apprentice gains by his axe and chisel. A reasonable amount of such manual labor will strengthen his growing muscles, expand his lungs, and lay the foundation for habits of activity. Much study is a weariness to the flesh, and particularly so for the young. Although eighteen is a very usual age to enter college, it would be far more profitable in most cases to wait a year or two longer, until the body has acquired greater strength and the mind greater capacity. For the years between fifteen and nineteen we can think of no better plan for a lad than the old-fashioned one of four month's schooling in the winter and eight month's work and play in the summer. During these early years also, the eye and the hand should be trained by practice in free hand drawing.

Let us now consider how the four years' course of education in civil engineering is spent, and what its effect is in drawing out and developing the powers of the young man.

The study of mathematics is continued, and embraces the subjects of geometry, algebra, trigonometry, descriptive geometry, co-ordinate geometry, and the calculus. There are courses in physics and chemistry. The study of the French and German languages is usually required, and training in the use of English is not neglected. There is a course in drawing beginning with the elements of projection, and including map drawing, perspective, machine and architectural drawing, and plans of structures. There is a course in surveying, embracing land surveying, leveling, triangulation and topography, railroad location, hydrography and geodesy. There are courses in the subjects of the strength of materials, the details of construction, the strains on roofs and bridges, the steam engine, the machinery for lifting and transporting, in hydraulics and in practical astronomy. There is also usually instruction given in metallurgy, mineralogy or geology.

These subjects are not taught by a single teacher but by a dozen or more, each of whom is, or ought to be, a specialist in his special department. He who teaches the surveying should have been for many years engaged in the actual practice of that art and have had charge of parties or important field work. He who teaches the details of construction should have actually built dams and abutments and bridges, and has shown himself competent to build them strong and cheap. In our best technical schools such teachers are, we think, generally selected, when it is possible to obtain them for the limited pay offered. The new scientific education, in fact, as distinguished from the old classical one of fifty years ago, has largely attained its great success through this careful selection of the teacher.

Under such instructors it would be expected that the methods of training would be largely practical, and this is found to be the case. Books of course are used, for they embody the record of the experience of all the ages of which we are the heirs, but the teacher should be independent of them, his function being to train the young men to think, and not, as in the old method, to simply hear the lessons recited. All that is read in the books receives full illustration in the practical work. In physics each student demonstrates in the laboratory the truth of the laws of falling bodies, of latent heat, and of the equivalence of motion and energy. In chemistry he learns about oxygen and chlorine by actually manufacturing these gases. In surveying he handles all the instruments in the field and takes all the notes necessary for the construction of his maps and profiles. And all these operations are so arranged that the young man sees and understands the reason why they are undertaken. When, for instance, he takes his

cross sections on the located railroad line he clearly sees the relation of the data thus obtained to a particular problem in his "geometry of earthworks." Or, when he makes his plans for a structure having columns, beams and rods, he is able to compute their proper sizes and shapes, or justify his selection of them by reference to good engineering practice. In short, the study and work is so arranged as to teach him to think for himself, to struggle with and conquer his problem, while at the same time this thinking and struggling is done mostly with those subjects upon which he intends to spend his future years.

The advantages of an education such as just described are many, and its disadvantages are few. The main advantage is the training which has developed the mind and character, and which renders the young man capable of exercising intelligent thought in whatever business he may undertake. The special information concerning engineering subjects acquired in such a course we consider to be of far less value than this general training. What he learns about surveying or drawing, the subjects with which he becomes most practically familiar, is not sufficient to enable him to take hold of any responsible work and execute it satisfactorily. He may be a good draftsman and a fair land surveyor, yet before he can be trusted far his judgment must be developed by the experience of actual business life. But the education that has taught him how to think will enable him to make rapid progress. The great field of science that has been opened to him by the study of astronomy, physics and geology will ever prove a pleasurable one in which he may roam during his hours of leisure, while his drill in the modern languages will have introduced him to the world of literature. His education has been broad, and this is well, for he who would build high must first build broad.

Viewed from a purely financial point of view, we think it could be shown, if statistics were obtainable, that a young man of good health and fair mental capacity, who takes such a course of study and graduates at the age of twenty-two, attains by the time he is thirty, a greater degree of success than he who plunges early into practice and follows closely some special branch. If, for instance, a census could be taken of all the young men of the age of thirty who are in charge of parties on railroad location or construction, it would be found that those who graduated from technical schools were receiving the highest salaries and had the best prospects for promotion, and further, we feel confident that in number they would far outrank the others. This cannot be said of men of fifty, for thirty years ago, when they were young, technical schools were scarcely known. To argue that because these older engineers have attained reputation and success without the advantages of scientific education the young men of to-day can do so likewise, is certainly fallacious, for the conditions in the two cases are far different.

An inspection of the lists of graduates given in some of the catalogues of technical institutes shows that young men who have been six years out of the school, in general, hold responsible and lucrative positions. On graduating they began at the bottom of the ladder with low pay, but they have rapidly mounted the steps, passing and often leaving far behind those who began the ascent when five years younger. In fact we know of no profession where the graduate advances so rapidly as in civil engineering. A young doctor finds it hard to obtain patients even when he furnishes both services and medicine gratis. A young lawyer is glad to take cases where he receives nothing if he loses, and almost nothing if he wins. But the young civil engineer earns at once as rodman or draftsman fifty dollars a month, and usually double or triple that amount after a very few years of practice.

The indications are, that technical education, as a qualification for technical pursuits, will grow every year more and more important, until finally it will become, as it is now in Germany, indispensible. Already some railroads hire for their field parties and drafting offices almost no others than technical graduates. They do this because they find it pays. A young man who is trained how to think is of more value to them at higher wages than one who does his work by rule of thumb at lower wages. He does more work in a day and does it better.

And when we look at the question from other points of view than the financial, everybody will agree that the young man of education has the advantage. The locating engineer, for example, does his work with a more cheerful mind, if he knows something about the rocks of the country through which he travels. He has an interest in the progress of science in general, as well as in that of his own specialty. When the panic comes that stops his work and his pay, he is not so bound to his trade that he cannot try his hand at something else. In such times, too, he feels at liberty to ask the alumni of his institution to assist in securing him employment. This may, perhaps, seem a trivial matter, but as a rule mens' lives are largely controlled by circumstances, while those who are able to control circumstances are few; and many a college man will testify to encouragement received from his brother alumni in times of commercial depression, encouragement without which his life might have been very different.

There is one other point, suggested by the remarks made, two weeks ago, by Herbert Spencer, concerning overwork and grey hairs, that should receive the careful attention of parents who are puzzled to know whether to give their boys a technical education or put them at once into practical work. Much of course depends on the boys, but if they have any liking for study, we say by all means let them continue at it. In these days of hurrying business rush and overwork, let us keep the young men out of the world as long as possible. Let the days of their youth be spent in academic halls, where the worry of business is unknown. Let the selection of their special branches of engineering labor be deferred until they are qualified by age and experience to select. Overwork and grey hairs come soon enough to men even when life is begun at twenty-two, and by commencing younger nothing whatever seems to be gained, but rather much seems to be lost.

To conclude: A young man who wishes to attain success and happiness in the occupation of a civil engineer ought to begin by obtaining a sound technical education.

CIVIL ENGINEERS' EMPLOYMENT BUREAU.

NEW YORK CITY, Nov. 18, 1882.

EDITOR ENGINEERING NEWS:

Do you know where I would be most likely to find work at railroad construction? I've hunted the city pretty well and have not been successful.

Last winter you found me work in Connecticut, and for it I felt very thankful.

I some time ago came off of the N. Y. C. & St. Louis R.R.; there I was running ballast stakes, etc. I have done more leveling than transit work, but have done all kinds of division work. Would like to get with a good man, where I could be advanced if worthy.

Why is not a place to be found in the city where a book could be kept, giving addresses and ability of engineers, etc.; also, at the same place, a list of work and the requirements, so a man need only to apply and know his fate without running around so much?

Railroad work especially needs such a department, as the work is sometimes short, and a forced idleness is the result until work can be found. All would be willing to pay for the trouble and would appreciate such an accommodation. Respectfully, F. M.

The above is but one of many similar requests of which we are in almost daily receipt. We heartily wish we could secure situations, more or less satisfactory, for them all, since they represent the willingness of a class to work if only work can be had. We have not met with many drones in the engineering profession, and whenever our assistance has been solicited to aid in finding situations we have made it our business to do the best we could for applicants. This service is, however, very insignificant, as in every office where engineers may be needed there is usually a more or less lengthy list of applications always on file. Some years ago we started an agency to meet this want of the profession; we received letters and testimonials from a considerable list of engineers, who, in the then complete stagnation of railroad building, and impecunious condition of municipalities, were out of employment. We had applications and they were usually of the following fashion: A chief engineer in Iowa would telegraph for a transitman and leveler; pay, $75.00 and found; wanted inside of two or three days. Nothing was said about transportation, how long the engineers would be wanted, and nothing about waiting till the parties could be found.

This is a pretty big country to get over in a day or two, and civil engineers are not usually kept "on tap" to be supplied at a moment's notice.

We would overhaul our statistics, and after laying aside a large and always augmenting list of "just graduated" who were ready to go anywhere at any price, but whom we could not well afford to indorse as "experienced engineers," we would select the most reliable man who was nearest the applicant, telegraph him the matter and leave him to do the rest. It always failed, and the only satisfaction we had was in paying telegraph charges. No sensible man would "pull up stakes" and travel, at his own expense and risk, across two or three States for the small consideration offered, and the contingency of not suiting, and so being left very much worse than before he started. Neither did we wish to be party to any such ventures. We sent an engineer from Boston to Pittsburgh to fill a situation; all parties were first-class but it wasn't long before the Boston man was back at "The Hub," we sent another from near Philadelphia to Buffalo, but it resulted in a similar retrograde movement; we got two or three into situations in which they are still, after nearly three years' holding, to the satisfaction of all concerned, we presume. With the return of good times, the demand for engineers for a while overtaxed the supply; there is now a falling off in railway building, and with it comes a large supply of unemployed engineers. A considerable number of these have really no claim to be called "civil engineers," and both themselves and the profession will be benefited by their turning their brain and muscle to other branches of business. There is another large class who will have to accept the situation, and take their enforced idleness as philosophically as possible; there are others who, having large experience, ought to be able to find professional employment all the time, or very nearly so. There is still another and increasing class of engineers, whom we wish to stimulate into opening offices for themselves, as specialists in one or more branches of the profession. In this great and rapidly-developing country there will always be a demand for engineering talent, and the men who become known and recognized as specialists will find remunerative employment. There should be an unremitting effort on the part of reputable engineers to maintain remunerative prices for their services, and as rapidly as possible introduce the practice of requiring payment for opinions or advice, which now seem to be considered by the public as worthless although eagerly solicited. The timely advice of an engineering expert will save to a client much expense and annoyance in many ways, and it ought not to be reckoned as gratuitous, while lawyers and doctors claim a fee for much less valuable services.

With regard to a record book, we would keep one if we thought it would be of any value. There is one now at the rooms of the American Society of Civil Engineers, for the benefit of members. How much it is utilized we do not know. Until we can devise something better, we can offer only the alternative of advertising in ENGINEERING NEWS. If this were generally adopted it would constitute a "record book," and it would, after a time, be consulted as such. Our charge for inserting such cards is only a nominal one of twenty-five cents each insertion; for parties who advertise for engineers we charge fifty cents. If only an occasional "Want" is advertised, we frankly say that the money is wasted; if it becomes general, it will soon become known among parties seeking engineers, and it would enable us to keep such a record well advertised before the proper parties. These printed cards would be pasted into a book,

which would gradually assume importance as a "record book," which would fulfill the requirements of our correspondent.

There is no advertising so valuable as that of a respectable newspaper; the business of the world now is divided into specialties, each with its recognized newspaper exponents. The more such a newspaper is patronized by the class whose interests it advocates, the more it is sought after by searchers for that particular information, and just in the same proportion it accrues to the interest of its patrons. We repeat what we have already said: a newspaper to live must be useful, and the more useful it becomes the more valuable it is to the publisher and his patrons. Use, then, your special journal to advertise your business wants, great and small, and you will soon discover how keen is the public to find out where to go to save itself trouble and expense.

PERSONAL.

A dispatch from Louisville, dated Nov. 21, states that GEN. F. DE FUNIAK, general manager of the Louisville and Nashville railway, has sent in his resignation to take effect Jan. 1. It was further stated that he had resigned in order to devote his entire attention to the Pensacola and Florida railroad, of which he will become president.

J. D. COOK, hydraulic engineer, of Toledo, O., who is now Consulting Engineer for the new water supply at Nashville, Tenn., is in Galveston, Tex., engaged in examinations preparatory to devising a system of water-works for that city. Mr. Cook is also engaged by the city of New Orleans to make designs and estimate cost of a thorough system of subsidence of Mississippi River water for that city.

RUDOLPH HERING, sanitary engineer, has changed his office from Philadelphia to New York, and all correspondence should hereafter be addressed to him at Room 18 Tribune Building. Mr. HERING'S first season, "on his own account," as a sanitary engineer has been an eminently successful one. He has been consulted on the sanitary condition of Cleveland, O., Racine and Appleton, Wis., Waterbury, Conn., Roanoke, Va., and Binghamton, N. Y., for which cities his reports and plans of sewerage have been adopted. He has also been called as consulting engineer at Sea Bright, N. J., and in several minor cases of sewerage and house drainage.

D. MCN. STAUFFER, M. A. Soc. C. E., formerly assistant engineer in the Philadelphia Water Department, afterward engineer for the contractor of the Dorchester Bay tunnel, of the Boston Improved Sewerage, late Principal Assistant Engineer "Bound Brook Route," Philadelphia to New York, has gone into business on his own account, with office at No. 18 Tribune Building, this city. The class of engineering work which he solicits is given in our advertising columns; his abilities as an engineer are too well known to need any further endorsement here. Mr. STAUFFER has just returned from Portsmouth, Va., for which city he is preparing plans for water-works.

CORRESPONDENCE.

BAD TASTE IN WATER.

NEW ALBANY WATER-WORKS COMPANY,
NEW ALBANY, Ind., Nov. 13, 1882.

EDITOR ENGINEERING NEWS:

I have seen, a number of times, discussions on the causes of the bad taste of water, which is palatable at its source. I have, between the reservoir and the valve on outside of reservoir, a small hydrant for the use of the keeper of the reservoir. The water from this hydrant, when the water in the pipes was shut off for two or three days in summer time, would always smell as if full of dead fish. I had soon after occasion to break the pipe, and found it covered with a network of brownish moss of just that same smell, only more so; while in the distributing mains I never found the moss; the pressure being 75 to 85 lbs., is evidently too great for vegetation. This only as an opinion for what it is worth. Yours truly,

FRANK SCHEFOLD, Civil Eng. and Supt.

IMPROVEMENT OF THE UPPER MISSISSIPPI.

Abstract of all proposals received and opened Nov. 7, 1882, by Major A. Mackenzie, Corps of Engineers, U S. A., Rock Island, Ill., for building brush and stone dams and shore protections in vicinity of Louisiana, Mo.

Names of Bidders.	Residence.	Brush. Per cu. yd.	Stone. Per cu. yd.
H. S. Brown	Quincy, Ill	1.25	1.76
Patterson Eros.	Keokuk, Ia.	.85	1.55
Frenis & Co.	St. Louis	.80	1.58
A. J. Whitney	Keokuk, Ia.	1.20	1.75

Abstract of proposals received and opened by Major A. Mackenzie, Corps of Engineers, U. S. A., Rock Island, Ill., Nov. 7, 1882, for building stone and brush revetment, below Quincy, Ill.

Names of Bidders.	Residence.	Brush. Per cu. yd.	Stone. Per cu. yd.
H. S. Brown	Quincy, Ill	.00	1.40
Patterson Bros.	Keokuk, Ia.	.90	1.80
A. J. Whitney	Keokuk, Ia.	1.00	1.65

ENGINEERS' SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting on the evening of the 15th inst., Vice-President Paine presided, and in the absence of Secretary Bogart, Mr. J. J. R. Croes officiated. Answers to the following circular letter had been received and abstracted by the secretary, and in that form were read by the acting secretary:

DEAR SIR: We are informed that there is included in the Army Appropriation Bill as recently passed by Congress and approved by the President a section making an appropriation of $10,000 for the use of the testing machine at Watertown Arsenal, containing also the following clause:

"The Chief of Ordnance shall give attention to such programme of tests as may be submitted by the American Society of Civil Engineers, and the record of such tests shall be furnished said society, to be by them published at their own expense."

The Board of Direction of this society desires to secure the best advice in reference to the action expedient to be taken under these circumstances, and has requested the President and Secretary to correspond with a number of those interested in the investigation, production and use of structural materials and obtain their views.

We, therefore, beg that you will advise us, first, how, in your judgment, can a programme of desirable tests of structural materials best be prepared? Second, give us such suggestions as may occur to you as to the general character and details of such a programme.

We may add that it is proposed to ask the co-operation of the Institute of Mining Engineers and the Society of Mechanical Engineers in this matter. An early reply will greatly oblige

Yours very truly,
President A. S. C. E.
Secretary A. S. C. E.

The following were elected:

FOR MEMBERS.

Augustus Jesse Bowie, Jr., Civil Engineer, San Francisco, Cal.

Collinson Pierrepont Edwards Burgwyn, U. S. Assistant Engineer, Richmond, Va.

Edgar Sheldon Cary, Res. Engineer New York, Ontario & Western R. R., Newburgh, N. Y.

Frank Hudson Clement, Div. Engineer South Pennsylvania R. R., Everett, Pa.

Frederick Y. Dabney, Chief Engineer and Superintendent Vicksburg, Shreveport & Pacific R.R., Monroe, La.

Edward Prince (elected Junior, Feb. 6, 1878), Superintendent and Constructing Engineer Water-Works, Quincy, Ill.

George M. Rusling, Engineer for Contractors New York, West Shore & Buffalo R. R., Newburgh, N. Y.

Edward Yorke, Chief Engineer Pacific Line, Mexican Central Railway, Guadalajara, Mexico.

Nov. 1, 1882.

The Nominating Committee has presented through Messrs. Fink and Gottlieb of the committee the following names of members selected as candidates for officers of the society for the year 1883: For President, Charles Paine; Vice-Presidents, Wm. H. Paine and Henry Flad; Secretary and Librarian, John Bogart; Treasurer, J. J. R. Croes. Directors: George S. Greene, Jr., Joseph P. Davis, Wm. Metcalf, Wm. E. Merrill, Wm. G. Hamilton.

WESTERN SOCIETY OF ENGINEERS.

The 157th meeting was held on Tuesday, Nov. 7, 1882, at 4 P. M., Vice-President Booth in the chair.

The minutes of the 155th meeting were read by the Secretary; also a letter from Mr. Willard S. Pope resigning the office of President on account of his going abroad for some time.

Adjourned.

No business was transacted at the 156th meeting.

L. P. MOREHOUSE, Secretary.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

ANALYSIS OF ARTESIAN WELL WATER FOR MADISON, WIS.—Prof. W. W. Daniells, chief chemist at the State university, has just completed an analysis of the water from the city artesian well, which is to supply the Madison water-works. The analysis is as follows, the composition being expressed in grains per United States gallon—a comparative statement of the composition of the Bethesda spring at Waukesha being also given:

	City well.	Bethesda.
Potassium sulphate	0.237	0.454
Sodium sulphate	0.286	0.542
Sodium phosphate	trace	trace
Bi-carbonate of soda	1.004	1.256
Bi-carbonate of lime	15.234	17.022
Bi-carbonate of magnesia	12.984	12.388
Bi-carbonate of iron	0 214	0.042
Sesqui-oxide of aluminum	trace	0 122
Selica	0.414	0.741
Sodium chloride	0.292	1.100
Organic matter		1.983
Total solid contents per gallon	30.755	35.710

The relative hardness of the city artesian well water and the water of the lakes is as follows: Lake water, 10.2: city well water, 7.3. It will therefore be seen that the lake water is forty per cent. harder than the city well water. Experiments were made regarding the effect of well water on metal pipe: After standing thirty days in contact with a clean piece of lead there was no indication of lead in the water; galvanized iron pipe under precisely similar conditions gave a trace of zinc in the solution. From this it will be seen that, unlike the water in many cities, ours does not affect lead pipe and therefore no harmful result can happen from the use of that metal; on the other hand, galvanized iron might produce slightly deleterious effects.—*Wisconsin State Journal.*

A FRANCHISE for the Danville water-works of Danville, Ill., has been granted to a company represented by Carrol E. Gray.

ONE mile of pipe has already been laid for the new Iowa City, Ia., water-works.

UPWARD of thirteen miles of water-pipes have been laid in Detroit this season.

CHEAP GAS.—A writer to the Richmond (Va.) *Despatch* says: It was my fortune to reside in Belfast, Ireland, for nearly seven years. I was a house-keeper and gas-consumer while in Belfast. The gas-works in that town are owned by the corporation, and all the coal used in the manufacture of the gas is brought across the channel from England, Scotland or Wales. Yet when I left Belfast the price to consumers was 3·9 sterling, or ninety-one cents per thousand feet of our money. The works in Belfast were originally built and put in operation by a London company, but a few years ago were purchased from them and are now owned by the corporation.

WATER-WORKS VOTED FOR IN STONEHAM, MASS.—On the 18th the vote by ballot was nearly three to one in favor of accepting the Quannapowitt Company's proposition to supply the town with water. This company is of Wakefield, and proposes to lay mains and pipes in both Wakefield and Stoneham, the supply lakes being in the former town. William B. Stevens, Esq., District Attorney, is the Chairman of the Stoneham Committee. It is understood that the work is to be commenced at once.

THE contract for the Sanford, Fla., water-works has been signed and delivered.

THE BOSTON WATER-SUPPLY.—The commission appointed to investigate the causes of the impurities existing in the Cochituate water supply visited Whitehall Pond, which indirectly furnishes a portion of the Sudbury River supply, to ascertain if any of the trouble comes from that source. The commission, before it makes its report, will examine every source of supply with a view of definitely settling the causes which have given rise to so many complaints.

RED BANK TO HAVE A WATER SUPPLY AT LAST.—Several of the New York fire insurance companies have ordered their agents at Red Bank, N. J., to cancel all policies on buildings in the thickly settled portions of the town since the late fire. The Board of Commissioners of the town signed a contract with the Shrewsbury City Water Supply Company, a corporation that only existed on paper, March 9, 1882, by which the incorporators of the Company were to erect water-works and supply the town with water inside of eight months. This time having expired without any work being done by the company a new one has been organized by the capitalists of the town. The incorporators are State Senator Applegate, Judge John L. Wheeler, Anthony Reckless, Treasurer of the New York & Long Branch Railroad Company; Isaac B. Edwards, cashier of the Second National Bank; Dr. Robert R. Conover, Edward E. Roberts

and J. A. Throckmorton. The new corporation has a capital of $100,000 and will be known as the Shrewsbury Water Company. Robert C. Bacot, the engineer of the State Board of Riperian Commissioners, is making the surveys of a number of streams of water near the town, and the new works will be erected at once.

ELECTRICITY.

UNDERGROUND TELEGRAPH SYSTEM.—PHILADELPHIA, Nov. 21.—An exhibition of an underground telegraph system was given here to-night in the presence of many electricians, business men, and members of the city Government. By this system the main trunk line is built large enough to carry several thousand wires, and also leave a passageway for a man to pass through to make repairs or lay new lines. From this main conduit, at the intersection of cross streets, small branches extend on each side under the gutter stones, while the houses are reached by boring through the solid earth and foundations. The test to-night of the electric light, Morse telegraph, and telephone lines, the conducting wires of which were laid side by side in the same trench, was deemed satisfactory, the induction between the wires being imperceptible.

The Wisconsin Telephone Company now controls one thousand miles of wire in the state.

RIVERS AND HARBORS.

THE MISSISSIPPI RIVER INVESTIGATION.—MEMPHIS, Tenn., Nov. 16.—General Q. A. Gillmore, President of the Mississippi River Commission, has addressed a letter to Mr. Burrows, Chairman of the Congressional Committee investigating the Mississippi River, saying that the present plan of the commission is to control the flow of the river by creating for it, within its present bed, a narrower conduit so arranged that the water shall be constrained to flow over the same path at all stages, and by its greater velocity and concentration of effort recover at the bottom the equivalent of the waterway taken from the sides.

RAILROADS.

THE ARKANSAS division of the St. Louis and San Francisco railroad is open for business to Van Buren, on the Arkansas River, opposite Fort Smith, 413 miles from St. Louis.

E. R. TRAFFORD, Civil Engineer of the South Florida Railroad, will commence the survey of the line from Kissimmee to Charlotte Harbor, about the 1st of December, with a view to its final location and extensions.

NEW LINE.—A dispatch from Pittsburgh to a New York paper gives as one bit of interesting fresh news that not only is a line from Columbus to New-Vienna, on the Marietta & Cincinnati, contemplated, but the money is ready, the pool formed, and actual work is about to begin.

CHEAP RIDING.—The distance from St. Paul to Chicago is 409 miles, and competition has reduced the passenger rate to twenty-five cents.

THE N. W. R. R. WAR.—As there seems to be some confusion of ideas about the exact cause of the present Northwestern row, it may be as well to explain its nature. The Chicago, Milwaukee and St. Paul Company has a main line from Chicago to St. Paul. The Chicago & Northwestern has for some time also run into St. Paul over the Chicago, St. Paul, Minneapolis & Omaha. A pool arrangement has hitherto existed between these two lines, but the Chicago, Rock Island & Pacific people, annoyed at the inroads which have been made into their territory by the other roads, resolved to retaliate, and by means of the Burlington & Cedar Rapids and the Minneapolis & St. Louis roads have acquired a direct route of their own between St. Paul and Chicago. Having done so, they demanded that they should be admitted into the pool, and upon the refusal of the other road they immediataly began to cut passenger rates, so that any person traveling from St. Paul to Chicago need now pay only 25 cents instead of the former fare of $13.

RAILROAD INTO THE ADIRONDACKS.—Two wealthy New England lumbermen propose spending $400,000 in building a railway into the Adirondack wilderness.

THE Austrian Ministry of Communications has granted to the Sudbahn or Southern Railroad Company the concession for the construction of an electric railway to run from Modling to Bruhl in the suburbs of Vienna. This will be the first electric line in the Austrian capital. It will be about three kilometers, or two miles, in length, and will run from the Modling Railway Station on the Southern Line through the village of Modling, and thence through Klausen to Volderbruhl. It will be a single line. The gauge is one meter, and the gradients are not to exceed 15 in the 100, while the minimum radius must not be smaller than 30 meters. The maximum speed allowed by the terms of the concession is 20 kilometers, or about 12½ miles an hour.

CANALS.

THE PANAMA CANAL.—A recent despatch from Aspinwall says: "It is reported that the canal company recently let a large number of contracts. Two of the most important are for cuttings. The first provides for a cut of seven miles on the Panama side, and includes that section extending from the Boca del Rio Grande—about a mile west of the city of Panama—to near Paraiso, on the line of the Panama Railroad. This cutting will be nearly all through swampy land, and the contract calls for the removal of 7,000,000 cubic meters of earth. The second is for a cut of the same distance from Culebra, on line of railroad, and was let at 52 2-10 cents per cubic meter. Canal agents have gone to Cartagena and Canca for men. The Jamaicans are not satisfied with the pay, and many of them work a few months and then go back home."

REVIVAL OF THE CAPE COD CANAL PROJECT.—BOSTON, Nov. 21.—The proposed revival of the Cape Cod canal project has already taken definite shape under new auspices. Capt. Nathan Appleton, in behalf of the would-be corporator's case, filed an application, to be acted on by the next Legislature, for a special charter, fixing the capital at $2,000,000. In conversation today, Capt. Appleton said there would be associated with him in the enterprise Count de Lesseps and Gen. Turr, the Hungarian, well known in connection with canal construction. New York, Boston and foreign capital will supply all needed support. Capt. Appleton further asserted that Mr. Whitney, president of the old company, is in full sympathy with the new enterprise and no opposition is anticipated from any source. Capt. Appleton claims to have received a hearty endorsement of the project from Gov. Butler. He estimates the cost of the undertaking at between two and three million dollars and the necessary time for construction at three years. Concerning the financial prospects of the enterprise, its projectors calculate on transporting an annual tonnage of about 5,000,000, at a toll of five cents per ton, yielding an income of $250,000. A greater tonnage than that mentioned, it is stated, now goes around the Cape. It is further announced that the work will be undertaken in earnest as soon as the necessary legislative sanction is obtained, probably in the early spring.

CONTRACTS LET.

WATER-WORKS CONTRACTS LET.—A special meeting of the Gloucester City, N. J., Council was held Nov. 23, for the purpose of awarding the contract for the construction of the proposed new water-works. The engineer employed has surveyed ground near Mount Ephraim, where the works will be erected. There is located there a number of natural springs, and this water is to be pumped to the city, a few miles distant. The contracts were awarded as follows: Furnishing and constructing the pipe system, Gloucester City Iron Works, at $57,377.39; stand-pipe, by the same company, $6,000; construction of dam, etc., John Eechbock, of Philadelphia, $7,141; Corliss engine, Wetherill & Co., of Chester, $14,550; erection of engine house and base of tower, Thomas Leaming, of Philadelphia, $6,112; furnishing fire protection, H. P. B. Birkinbine, of Philadelphia, $2,500; total cost, $93,680.39.

GRANITE CONTRACT LET.—The Treasury Department has awarded the contract for granite work about the approaches to the public building at Hartford, Conn., to the Mount Waldo Granite Company, of Frankfort, Me.

RAILROAD CONTRACT LET.—The *Citizen* of Jackson, Mich., states that the contract for constructing the road-bed of the Grand Trunk extension from Pontiac to Jackson has been awarded to S. C. Brooks & Co. The road, by the terms of the contract, must be in readiness for the iron in thirteen months.

BUILDING.

AN UNHEALTHY HEALTH OFFICE.—WASHINGTON, Nov. 17.—The Health Officer of the District has been informed by the Inspector of Plumbing that the building occupied for several years by the Health Office is in very bad condition, with evidence of leaking sewers, extensive soil pollution, and sickening odors. He recommends that the rules governing plumbing and house-drainage be rigidly enforced in the Health Office itself.

NEW PENSION OFFICE.—Gen. Meigs says that as soon as his plans are approved by the Secretary, he shall begin work on the new pension office in Washington immediately thereafter.

MISCELLANEOUS.

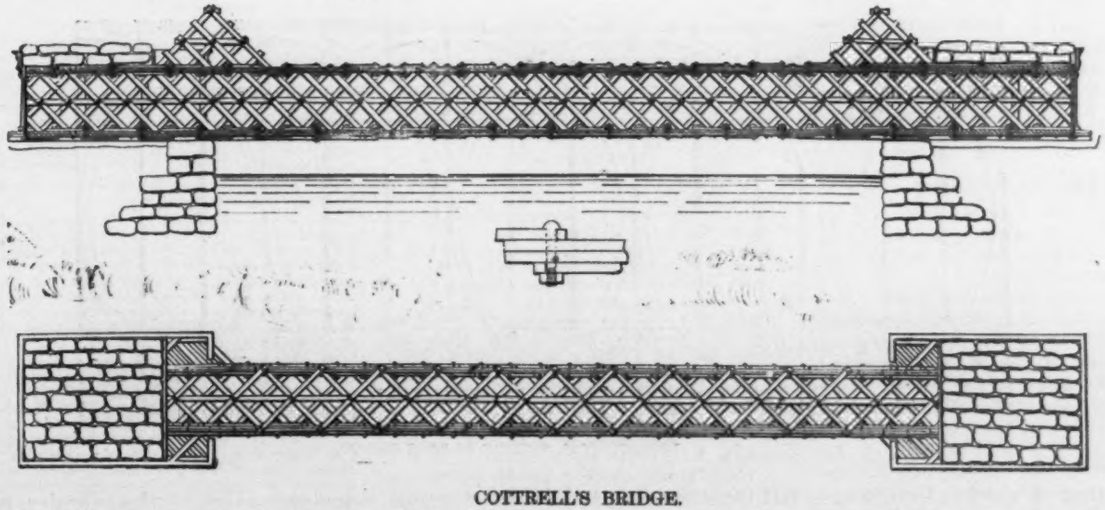
A BLAST of 6,000 pounds of powder was exploded on the Oregon & California railway. This is said to be the largest blast ever undertaken on the Pacific coast.

TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

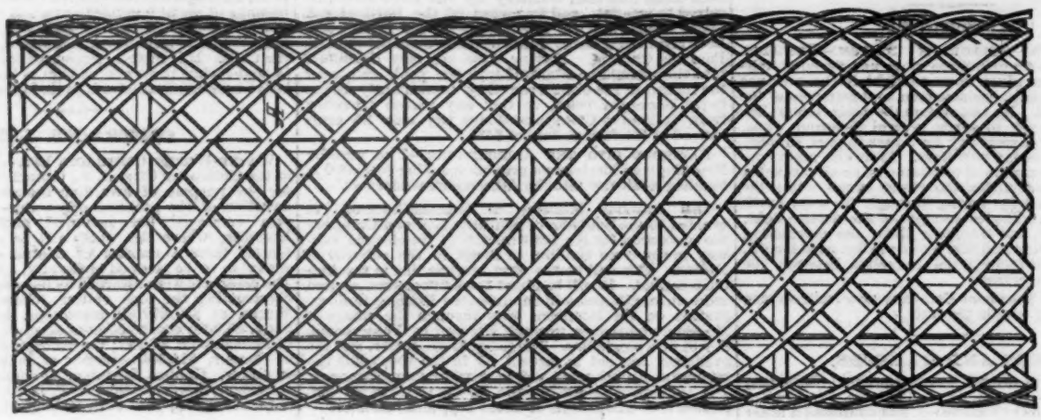
On the 10th of November, 1841, Albert Cottrell, of Rhode Island, obtained a patent for a bridge. The distinguishing feature of Cottrell's construction consists in supporting the bridge during the process of building, as well as after completion, by the application of a balancing power comprising stone laid upon a part of each end of the bridge projecting in rear of its abutment, thus preventing a depression or sag of the bridge. The structure is given the appearance of a very flat segment or arch. The inventor states that, by his construction, a bridge may be erected of any required span without sustaining piers between the abutments. He asserts, moreover, that by a continual addition of the balancing power he can project the bridge across the



COTTRELL'S BRIDGE.

*Copyright, 1882.

stream without the use of centering. When continued a sufficient length, the opposite or projected end of the bridge may be lowered upon the abutment on the other side of the river, by removing a suitable quantity of the balancing material, and when this end is properly weighted, the operation is completed. The "lattice" system of truss is employed, with some modifications, shown by the drawings.

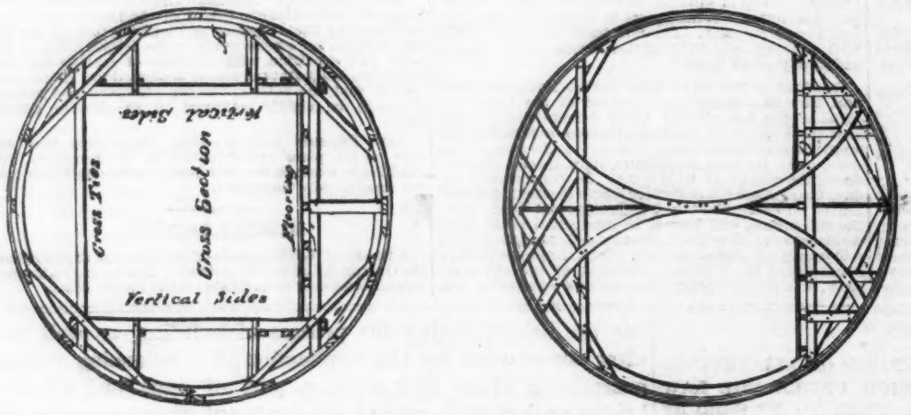


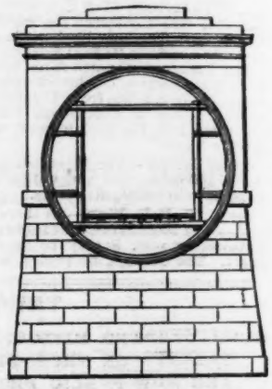
ROGER'S BRIDGE.
SECTION SHEWING RIBS AND STRING-PIECES WITH THE CROSS-BAR IN WOODEN BRIDGES.

In the same year and date Isaiah Rogers, of New York, got up a "spiral braced cylinder bridge."

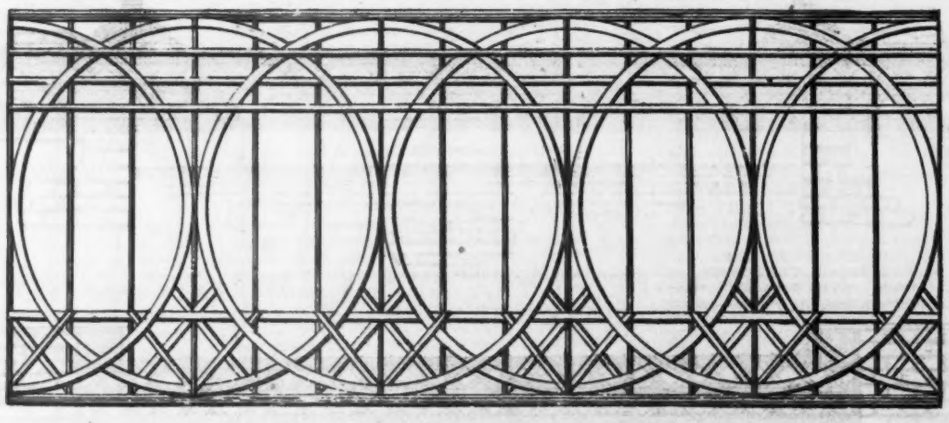
Rogers proposed to make the exterior framework of this bridge either of wood or iron, and so put together as to constitute a complete latticed bridge from end to end, the lattices being formed by spiral braces surrounding the cylinder. Within the cylinder is constructed a hollow rectangular prism which constitutes the passage-way of the bridge. The vertical sides of this road-way are formed by a series of rings united together, and to vertical studs and horizontal string-pieces by means of bolts. In bridges of a long span the road-way is to be divided into two parts by a central partition.

In bridges of iron the bars which form the circular ribs may be bent edgewise. As there is not any lateral thrust upon the piers the bridge may be laid in stone masonry or on piles. When a bridge of this kind is to have a span of unusual length one or more arched tubes may be constructed upon the same principle as that of the cylinder, and placed below the cylindrical bridge, its ends bearing against suitable abutments, and its crown-plate coming in contact with the center of the bridge on its lower side.





ELEVATION OF PIER ON WATERSIDE.



LONGITUDINAL SECTION IN IRON BRIDGE.

(TO BE CONTINUED.)